

ILLUminate Blog Transcript: Muzhe Yang on Factors Affecting Maternal, Fetal and Infant Health

Recorded March 8, 2021. Listen to it [here](#).

- ANNOUNCER: 00:02 (MUSIC) This podcast is brought to you by ILLUminate, the Lehigh Business blog. To learn more, please visit us at business.lehigh.edu/news.
- JACK CROFT: 00:13 Welcome. I'm Jack Croft, host of the ILLUminate podcast for Lehigh University's College of Business. Today is March 8th, 2021. And we're talking with Muzhe Yang about his research looking at how various factors during pregnancy — including light pollution, most recently — affect fetal and infant health. Dr. Yang holds the Charles William McFarlane Professorship in Economics in Lehigh's College of Business. His research aims to provide empirical evidence on causal relations that have policy implications. Examples in recent years include fetal health effects of long commutes to work during pregnancy, maternal and fetal health effects of working during pregnancy, and the effects of power plant emissions, air pollution, noise pollution, light pollution, and water pollution on fetal and infant health. We'll be talking about all of those. In recent years, a common thread tying together much of your research has been a focus on how a range of factors affects fetal and infant health, including babies born at low birth weight. How did you first become interested in this topic?
- MUZHE YANG: 01:25 Well, the story goes back to a study I did about 10 years ago on the impact of California's paid family leave on mothers' breastfeeding behaviors. Well, during that study, I learned that the U.S. is the only high-income country that does not guarantee paid leave to new mothers. I was also shocked to learn that the U.S. is ranked very last on every measure of family-friendly policies among all high-income countries. All this learning has made me become interested in topics related to maternal and infant health. Also, to my surprise, the paper I did on California's paid family leave later was cited by the Council of the District of Columbia regarding Washington, D.C.'s paid family leave, which became effective in 2017. This experience let me realize that what we do as a researcher actually can influence policymaking. And I see my research endeavors as a way of speaking for the vulnerable members of a society, such as infants and pregnant women.
- CROFT: 02:40 The latest research you and your colleagues published found that light pollution could increase the likelihood of a pre-term birth by 12.9% as a result of nighttime brightness. What are the main sources of light pollution? And what is the connection between nighttime brightness and low birth weight, shortened gestational length, and pre-term births?
- YANG: 03:03 Light pollution includes three components: sky glow, light trespass, and glare. In our study, we focused on skyglow, which is the main component of the three. Skyglow is a result of artificial lighting at night. One important thing we need to note is that exposure to artificial lighting at night can disrupt our human bodies' biological clock. Specifically, the disruption is a suppression of the production of melatonin, a hormone that regulates a human's sleep/wake cycle. The biological mechanisms underlying our findings and suggested by the medical field includes two parts. One is the impact of skyglow on sleep deprivation through the disruption of the biological clock. And the other is the impact of sleep deprivation on adverse birth outcomes through inflammation that results from poor sleep.

- CROFT: 04:07 Now, how extensive is the problem of light pollution, both in the United States and around the world?
- YANG: 04:14 It is a worldwide and ongoing problem. In many cities in the U.S., artificial lighting at night is nearly 10 times brighter than natural nighttime light. Studies have shown that in recent years, there has been an increase in light pollution in many countries. And light pollution has remained consistently high in some countries like the U.S., Spain, Italy, and the Netherlands.
- CROFT: 04:44 What, if any, are the policy implications to this study that should be looked at?
- YANG: 04:52 Yes. Indeed. There have been some legislations going on across the country, as regarding the proper use of street lights. So all the lights actually should just use for the ground and not just upward lighting positions. So it is about the proper usage of lighting at night, especially for street lighting.
- CROFT: 05:16 All right. Now, light is only the most recent form of pollution you've explored in connection with fetal and infant health, as I mentioned in the introduction. Let's talk about the others you've studied, starting with air pollution in the form of power plant emissions from a Pennsylvania plant located across the Delaware River from New Jersey. What were the main findings of that study? And what did it tell you about the policy implications related to, particularly, environmental regulations?
- YANG: 05:45 In this study, we find that babies born to mothers living as far as 20 to 30 miles away from the power plant have a higher likelihood of having low birth weight, birth weight below 5.5 pounds, by 6.5%, during the period when the power plant was in operation. In a follow-up study, we find that a shutdown due to a landmark ruling by the EPA reduces the likelihood of having a low birth-weight baby by 15% in the area downwind of the plant. The ruling that eventually led to the shutdown of the plant is the first-ever, federal-level regulation under the Clean Air Act that overrides state level regulations and is imposed upon a single pollution source. The study about this Pennsylvania power plant located on the PA-New Jersey border highlights the fact that regulating air pollution is not easy because it is a kind of pollution that can travel across state borders. The approach we currently use, which relies on each individual state to meet the air quality standards set by the EPA, is not fully effective. I hope the study about the Pennsylvania power plant can draw policymakers' attention regarding the importance and necessity of using direct federal-level regulation on pollution source in solving the cross-border air pollution problem.
- CROFT: 07:23 Right. And clearly, the problem is that state borders, we don't have huge walls or anything that stops whatever is in the wind from going back and forth across those.
- YANG: 07:38 That's right.
- CROFT: 07:38 So anything that doesn't regulate across those borders certainly, just can't be effective, right?
- YANG: 07:48 That's right.
- CROFT: 07:49 Now, you also looked at increased residential noise pollution, in this case stemming from proximity to air traffic, and how that could increase having low birth-weight babies for mothers living close to the airport in the direction of the runway. And with that one, that was prompted — just like the power plant one, with a change in EPA regulations — there was a change in a Federal Aviation Administration regulation that

kind of changed circumstances for people who live near airports. Can you talk about what that-- and this is interesting because you talk about how your work affects policy. There's a case where a policy decision was made, probably for reasons that made sense to the people who made it, but had these unintended consequences.

YANG: 08:44

Yes. That's right. So if you purchase a house, you can choose things on the ground, but you do not have the control on things over your head.

CROFT: 08:52

Now, what was the change that the FAA made?

YANG: 08:55

Well, this is a new thing called the Next Generation Air Transportation System initiated and implemented by the FAA. The new system uses precision sensor monitoring. This replaces the old-fashioned radar-based surveillance. So the result is allowing more airplanes to be able to fly closer to one another on the same path that is optimal, in terms of minimizing the distance and saving fuel. As a result, the flight paths have become more concentrated than before, and those living underneath have become the victims of an unexpected air show. And there have been studies about the trade-off between the flight path optimization and adult health, measured by reduced quality, adjusted life years. And our study broadens the scope of that finding by taking into account compromised fetal health as a result of flight path optimization.

CROFT: 10:00

And what did the study find, in terms of the effect on pregnant women and their babies?

YANG: 10:07

Yes. We do find adverse effects all the time related to living close to the airport, specifically in the direction of the runway. And there is a significant increase in the incidence of low birth-weight babies and also pre-terms among mothers who live within 5 miles of the airport in the direction of the runway.

CROFT: 10:33

It strikes me, as you talk about this, that in terms of bright street lights, in terms of air traffic, I think a lot of people feel like, "Well, if you live there, you get used to it." And it sounds like from the results of your studies that, you not only don't get used to it, but it has direct impacts on the quality of health.

YANG: 10:54

Yeah. This is actually a very important question. So noise pollution actually, sometimes is referred to as a silent killer. Why? Because the connection is the activation of the central stress system, central stress response system of a human body, and the so-called HPA axis. And this activation by noise can lead to disruptive sleep, increased release of stress hormones, and increased blood pressure. One important feature of this response of the HPA system in our body is that it doesn't require cognitive perception of the noise. So that means if you just make peace with the noise, it doesn't mean nothing will happen to your body when you are exposed to a higher level of noise.

CROFT: 11:41

That's very interesting. I had not heard that before. Now, I know that you've also been working on a study related to water pollution recently, but that has not been completed. Can you just kind of give us the broad outlines of that at this point?

YANG: 11:57

Yeah. This is an ongoing project looking into the recent lead in drinking water crisis in Newark, New Jersey. This study highlights the issue of lead exposure, which is prevalent in the U.S. because of the large number of lead pipes as part of our aging infrastructure. In this study, we explored exogenous variation in exposure to lead in

tap water across similar models within the same locality, in order to refer to causal effects on birth outcomes. And we are still working on it.

CROFT: 12:37

Okay. We'll check back with you once that one is published, as well. Besides pollution, you've also looked at the connections between, I guess, broadly, working conditions for pregnant women and adverse birth outcomes. You had a study in which you looked at pregnant women who commute 50 miles or more to work each way. Can you talk about what you found with that? And again, what implications might be for women who have to commute a long way when pregnant?

YANG: 13:14

Yes. Yes. So for the study on the long commutes to work during pregnancy, we find that among long-distance commuters who travel at least 50 miles to work, increasing the travel distance during pregnancy by 10 miles could potentially increase the risk of having a low birth-weight baby by about 14%. In addition to maternal stress induced by this long commute being one potential mechanism, we also find evidence of long commutes during pregnancy being associated with underutilization of prenatal care. Our study also highlights a self-reinforcing mechanism among pregnant women who are long commuters, which is this: Those who are in greater need of prenatal care because of the potential adverse effect of stress triggered by the long commutes are actually underutilizing prenatal care, which could lead to even worse birth outcomes. One possible way to break this self-reinforcing mechanism is facilitating the utilization of prenatal care, for example, through the expansion of maternity leave to cover the prenatal period. Here, I want to mention that even in the era of remote working becoming permanent, remote working itself doesn't necessarily make prenatal care an easy thing to do. Therefore, it is still an important policy question regarding how to facilitate the usage of prenatal care, even when remote working becomes a permanent option.

CROFT: 15:00

Another working condition aspect that you looked at involved pregnant women with work that was measured as more strenuous. Can you talk about what that study found? What constitutes more strenuous work, where it would have an effect on birth outcomes, and what that may indicate about policies, particularly about workplace accommodation?

YANG: 15:29

Arguably, this is the first study providing empirical evidence of maternal and fetal health effects of working during pregnancy. We are able to do this study because of a unique data set from the New Jersey Department of Health, which includes information not only on pregnancy and birth outcomes, but also on maternal employment. So in this data set, we observed information on the occupation of each mother. And then using this information, we are able to get a numerical value called the metabolic equivalents of task, which will indicate how high or how low the physical activity is-- how demanding the physical activity is.

CROFT: 16:13

Yeah. In terms of those who were doing work that was more physically demanding, what were the effects that you saw?

YANG: 16:22

Yeah. So we focused on those settings where laws regarding reasonable accommodation for pregnant women are already in place. But we still find evidence that working in strenuous jobs during pregnancy increases the likelihood of a specific adverse birth outcome called fetal macrosomia by about 70%. So fetal macrosomia refers to birth weight above 4,000 grams, or 8.8 pounds. So, yeah, although we do not find the effects on other birth outcomes, such as low birth weight or pre-term, we're

finding a significant increase in fetal macrosomia. Nevertheless, highlights a possible deficiency of existing accommodation laws intended to protect pregnant workers. In addition, our study indicates an understudied link between gestational diabetes, which actually is a known risk factor for fetal macrosomia, and intensive physical activities at work during pregnancy, potentially mediated by disrupted sleep due to greater work intensity.

CROFT: 17:35

This has all been very interesting. And it reminds me of something you had said when we first talked about your research three years ago. And I'll read back that quote where you had said, "As an economist, I am always thinking about trade-offs, the benefits, and costs of decisions, as well as the unintended consequences such as externalities." And I'm wondering what insights you've gained about those trade-offs from your research in the area of fetal and infant health, in particular, over the years of looking at these kinds of issues?

YANG: 18:14

Usually, the trade-off is a result of making an optimal decision under a constraint. If there are no constraints, there will be no trade-offs. And very often, the trade-off is not a situation that is unique to a single person, a single state, or a single country. So I think it is important to learn from others about how to deal with the trade-off. Here, let me use light pollution as an example. A bright night sky is often viewed as a symbol of prosperity. Indeed, some economic studies have already used satellite imagery data of nighttime sky brightness to infer economic growth. So it appears that artificial lighting at night is the price we have to pay for economic development. But in reality, it doesn't have to be this way. Take the comparison between the U.S. and Germany as an example. Studies have shown that cities in the U.S. use many times more artificial lighting at night per capita than cities in Germany. Some of the difference in lighting usage could be explained by the fact that cities and towns in Germany are lit much more conservatively at night. So this comparison between two equally prosperous countries highlights the possibility that light pollution is still a choice which should be made after careful consideration of all of its potential costs and benefits. So in the case of light pollution, and more generally, I believe there is always a lot to learn from others in dealing with the trade-off that comes from making optimal decisions under constraints. We need to be careful observers.

CROFT: 20:24

Yeah. Because I know in most of the cases that I'm familiar with, at least, regarding the brightness of lights in cities, the discussion seems to focus almost exclusively on safety. And that--

YANG: 20:37

That's right.

CROFT: 20:38

--having it look as bright as day will make your city safer. And I don't know that these other factors are even discussed as they're making those kinds of decisions.

YANG: 20:52

Yeah. So as I mentioned earlier, so there have been legislation in the U.S. about the proper use of street lighting. And actually, more recently in January 2019, April 2020, lawmakers in Massachusetts also introduced bills in the House and Senate, including a call to study the adverse health impact of excess light exposure aimed at reducing light pollution through shielding the roadway and public lighting. I also want to mention that in the EU, the European Union, has issued a call for all outdoor lighting to follow the rule of lighting at levels as low as reasonably achievable. And this is commonly known as ALARA [an acronym for as low as reasonably achievable]. So this call is really combined with the expectation that street lights should not radiate above

a horizontal plane from the source, and it requires that street lighting should dim at curfew. So in our study of light pollution suggests that we should be aware of the health effects of lighting at night.

YANG: 22:08

Dr. Yang, I'd like to thank you for being with us, and it's been--

YANG: 22:11

Well, thank you for giving me this opportunity.

CROFT: 22:14

Yeah. It's been most interesting. And it's been fun kind of being able to put all of the work you've been doing in perspective and kind of look at it as a whole, so. And we look forward to, as you continue exploring these areas, of talking with you again.

YANG: 22:31

Okay.

CROFT: 22:32

Among other examples of Dr. Yang's research are peer effects in physicians' new drug prescription behaviors, the impact of publicly reported provider quality information on coronary artery bypass graft markets, the impact of exposure to food advertising on purchasing behaviors, the roles of nationality and ethnicity and international and interregional trade, the effects of signaling behaviors on college admission outcomes, and as he mentioned early on, the effects of paid maternity leave on breastfeeding practices. This podcast is brought to you by ILLUminate, the Lehigh Business blog. To hear more podcasts featuring Lehigh Business thought leaders, please visit us at business.lehigh.edu/news. And don't forget to follow us on Twitter @LehighBusiness. I'm Jack Croft, host of the ILLUminate podcast. Thanks for listening. (MUSIC)